

## EXTINCTION OF SELF-INJURIOUS ESCAPE BEHAVIOR WITH AND WITHOUT INSTRUCTIONAL FADING

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Three individuals with developmental disabilities participated in a study of the treatment of self-injurious behavior (SIB) maintained by negative reinforcement (escape from educational tasks). Treatment was implemented in a multiple baseline design across subjects, in which two treatments were compared in a multielement format. Both treatment conditions included an escape-extinction component in which SIB no longer produced escape. One of the conditions also included a fading component in which the frequency of instructions was initially reduced to zero and then was gradually faded back in across sessions until the instructional rate matched that of the original baseline. Results indicated that extinction alone reduced SIB to the end-of-treatment criterion in fewer sessions than did extinction plus fading for all 3 subjects. For 2 of the 3 subjects, however, there was an initial increase in the frequency of SIB at the outset of treatment with extinction (an extinction burst) that was not observed when extinction was combined with the fading component.

**DESCRIPTORS:** extinction, functional analysis, negative reinforcement, self-injurious behavior, stimulus fading

Research has shown that self-injurious behavior (SIB) can function as an escape response when it terminates certain ongoing activities such as academic or work tasks (e.g., Iwata, Dorsey, Slifer, Bauman, & Richman, 1982; Steege, Wacker, Berg, Cigrand, & Cooper, 1989). One approach to reducing the frequency of such behavior consists of presenting the activity while preventing escape; that is, withholding negative reinforcement. This procedure has been described as "escape" extinction and has been shown to be an effective treatment

for escape or avoidance behavior (Heidorn & Jensen, 1984; Repp, Felce, & Barton, 1988; Steege et al., 1989). For example, Iwata, Pace, Cowdery, Kalsher, and Cataldo (1990) implemented escape extinction with 6 individuals during training sessions. Instructions were delivered at regular intervals, and trials were not terminated if a subject exhibited SIB; instead, the subject was guided through the task and the next trial was presented. Thus, SIB did not produce escape from educational tasks and, as a result, was extinguished in all subjects.

One possible limitation of extinction is a temporary increase in responding during the initial stages of treatment. For example, some of the subjects in the studies by Repp et al. (1988) and Iwata et al. (1990) showed a "burst" of SIB when escape ex-

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tion was first implemented. This potential problem can make extinction procedures for SIB or aggression difficult from a practical standpoint because an increase in the behavior can be dangerous to either the individual or those in the individual's immediate environment. Thus, to the extent that escape extinction produces a typical extinction burst, its therapeutic use may be limited to individuals whose behavior problems do not pose severe risk.

Pace, Iwata, Cowdery, Andree, and McIntyre (1993) attempted to prevent the occurrence of extinction bursts by using a stimulus-fading procedure in conjunction with escape extinction while treating the SIB of 3 individuals. During the first few treatment sessions, no instructional trials were presented. Subsequently, the rate of instructions was increased gradually (i.e., faded into the training sessions) until it eventually matched that of the original baseline. This procedure, combined with escape extinction, resulted in large and immediate reductions in SIB that were maintained throughout treatment. A component analysis conducted with 1 of the 3 subjects showed that SIB increased above its baseline level when extinction was implemented without the fading procedure.

Although the results reported by Pace *et al.* (1993) are quite promising, they must be considered tentative because the effects of extinction plus fading were compared to those of extinction alone with only 1 subject and only during the initial treatment sessions. Thus, the extent to which an extinction burst would have occurred for 2 of the 3 subjects was not determined. Furthermore, even if extinction resulted in temporary increases in all subjects' SIB, it is possible that treatment may have proceeded more rapidly in the extinction-alone condition (which did not contain a protracted fading procedure).

The purpose of this study was to extend the findings of Pace *et al.* (1993) by using multielement designs to compare the therapeutic effects of extinction with and without instructional fading on SIB maintained by escape. In addition, the procedures were continued long enough to determine

the length of time (number of sessions) required to reach a prearranged end-of-treatment criterion.

## METHOD

### *Subjects and Setting*

Three adult women living in a state residential facility participated. All of them were diagnosed with profound mental retardation. Lisa was a 39-year-old woman with Down syndrome whose SIB consisted of hitting her face in the area of her cheeks and temples. Her SIB posed a moderate risk of tissue damage and significantly interfered with her daily training. Lisa was ambulatory and had no sensory or motor impairments. She followed simple (one-step) instructions but had no expressive language. Karen was a 26-year-old woman whose primary forms of SIB were hand biting and face slapping. She also hit other parts of her body or stationary objects and frequently engaged in disruptive behavior (e.g., throwing task items) and aggressive behavior toward staff. Karen's SIB posed a moderate risk of tissue damage, particularly where she bit her hand. Karen was ambulatory and had no sensory or motor impairments. She followed most instructions, but her expressive skills were limited to a few utterances. Diane was a 32-year-old woman with Down syndrome. Her SIB consisted of head banging against stationary objects and hitting her head with her hand, fist, knee, or foot. Diane's SIB posed a severe risk of tissue damage, and she wore a protective helmet at all times except during meals and bathing. Diane had a cataract in one eye, but she was fully sighted in the other eye and had no motor impairments. She had good receptive language (she could follow two-step instructions) and an expressive vocabulary that consisted of approximately a dozen manual signs. None of the subjects received psychotropic medication during the course of the study.

The study was conducted on the grounds of the facility at a day program for the assessment and treatment of SIB. Two to five sessions were run individually with each subject 5 days per week in therapy rooms (approximately 4 m by 6 m or 7

m by 13 m). Sessions lasted for 15 min, separated by breaks lasting 10 to 15 min.

### *Response Measurement and Reliability*

Self-injurious responses were defined as follows: face/head hitting—audible contact of a hand, knee, or leg against any part of the face or head; slapping—audible contact of any part of the body against another part of the body (other than the face or head) or against a stationary object (e.g., furniture, floor, or wall of therapy room); head banging—audible contact of the head against a stationary object; and hand biting—closure of the teeth on any part of the skin from fingertips to wrist. Data were also collected on disruption and aggression (for Karen), compliance with instructions, and the rate at which instructions were presented by the therapist. An observer was present during each session and recorded subject and experimenter behavior on a hand-held computer (Assistant, Model A 102) during continuous 10-s intervals. Session data were converted to responses per minute (SIB, aggression, disruption, and instructions) and percentage compliance (percentage of instructions with which a subject complied).

Interobserver agreement was assessed by having a second observer simultaneously but independently collect data during 29% of the sessions of the functional analysis (for Karen and Lisa), 29% of all baseline sessions, and 25% of all treatment sessions. Agreement percentages were calculated based on interval-by-interval comparisons of the observers' records, in which the smaller number of responses in each interval was divided by the larger number of responses. These fractions were then summed across all intervals and divided by the total number of intervals in the session to get the percentage agreement between the two observers. Mean overall agreement scores and ranges for SIB during assessment (for Karen and Lisa), baseline, and treatment, respectively, were as follows: Karen—97.3% (91.4% to 100%), 91% (89.6% to 93%), 98.1% (77.6% to 100%); Diane—89.8% (85.1% to 91.7%) and 99.4% (96.5% to 100%); Lisa—

99.4% (97% to 100%), 95.6% (91.0% to 98.8%), and 98.6% (93.8% to 100%).

### *Experimental Sequence and Designs*

The first phase of the study consisted of a functional analysis assessment, in which a series of conditions was presented in a multielement format (Sidman, 1960; Ulman & Sulzer-Azaroff, 1975). The purpose of this analysis was to identify the variables maintaining Lisa's and Karen's SIB. Diane did not participate in this phase of the study. A previous functional analysis revealed that Diane's SIB was maintained primarily by attention. Subsequently, the behavior was treated successfully with a differential reinforcement procedure that was unrelated to the present experiment and is not described here. Informal follow-up observations at Diane's residence indicated that she continued to exhibit SIB in several isolated situations. Before undertaking a complete repetition of her functional analysis, additional descriptive data were collected and indicated that SIB occurred only following instructions requiring physical activity (e.g., "walk over here"). Based on these data, we suspected that Diane's SIB was maintained by escape. This conclusion was verified when a baseline condition was initiated; therefore, Diane was included only in the treatment phase of this study.

Following completion of the assessment, baseline data were collected for all 3 subjects. Treatment was then introduced according to a multiple baseline across subjects design. For each subject, two treatment conditions were presented in a multielement format. One treatment consisted of extinction of escape behavior; the other consisted of escape extinction plus demand-frequency fading. Each phase is described below.

### *Functional Analysis*

Lisa and Karen were exposed to four assessment conditions. A brief description of each condition is provided here; complete details can be found in Iwata et al. (1982). During the attention condition, the subject was in a therapy room with a variety

of leisure materials available. At the beginning of the session, the experimenter entered the room, informed the subject, "I will be here if you need me," and then ignored the subject. Contingent on the occurrence of SIB, the experimenter approached the subject, provided attention in the form of concern and disapproval of the behavior (e.g., "stop that, you'll hurt yourself"), and briefly interrupted the SIB through response blocking. During the demand condition, the experimenter presented academic or physical tasks at the rate of one every 30 s. The experimenter delivered praise and physical contact (pats on the back) when the subject complied with the task. If the subject exhibited SIB during any part of the instructional sequence, the experimenter terminated the trial and implemented a time-out until the next scheduled instruction. During the alone condition, the subject was in the therapy room alone without any leisure materials. The final condition, play, served as a control. In this condition, leisure materials were made available, and the experimenter provided attention to the subject every 30 s. Any SIB that occurred during the session was ignored.

### *Treatment*

**Baseline.** Procedures in effect during baseline were identical to those in the demand condition of the functional analysis. The experimenter presented learning trials once every 30 s and delivered praise and physical contact contingent on compliance. If compliance was not initiated within 5 s of the initial instruction, the experimenter modeled the response and, if necessary, provided physical guidance 5 s later. Trials were terminated contingent on the occurrence of SIB at any time during the instructional sequence. The tasks required moderate physical activity (e.g., "stand up," "come over here," "put on your shoe"), were similar to those found in the subjects' individual educational plans, and consistently produced SIB during the functional analysis assessment or during informal sessions conducted at the beginning of the study. For each subject, baseline sessions were conducted by two experimenters who later would be paired with the dif-

ferent treatment procedures. The order of sessions throughout baseline and treatment was semirandom, with no more than three consecutive sessions presented by one experimenter.

**Escape extinction.** Treatment was implemented in a manner identical to that described by Iwata *et al.* (1990) and Pace *et al.* (1993). All aspects of this condition were the same as in baseline, except that SIB did not produce escape (termination of a trial). If the subject emitted SIB at any point during the trial, physical guidance was provided immediately, and the session continued accordingly.

**Escape extinction plus instructional fading.** Consequences for compliance, noncompliance, and SIB were the same as those in the extinction condition. In addition, all instructions were eliminated from the initial treatment session and subsequently were faded in across sessions based on a subject's observed rates of SIB. The frequency of instructional trials per session was increased by one if the subject's SIB was at or below 0.5 responses per minute during a previous session (this rule was modified after Session 39 for Diane; instructions were increased by two per session if her rate of SIB was at or below 0.5 per minute). The eventual goal was to increase the rate of instructions until their frequency matched that of the baseline and extinction conditions (two per minute). The extinction-plus-fading procedure was thus very similar to that used by Pace *et al.* (1993), with the additional feature of explicit fading criteria.

### *Treatment Effectiveness*

In order to evaluate the relative effects of the two treatment procedures, a criterion was established prior to treatment to indicate when a treatment condition was considered to be effective. This criterion was set initially at or below 0.5 self-injurious responses per minute for five consecutive sessions, with an instructional rate of two per minute. Karen's criterion was later modified to one self-injurious response per minute for five sessions in a row. Given Karen's baseline rate of SIB and the rate of instructions, this criterion was determined to be a clinically significant reduction. When the

criterion was met in one treatment condition, that condition was discontinued.

## RESULTS

Results of the functional analysis assessment for Karen and Lisa are shown in Figure 1. Both subjects exhibited the highest rates of SIB during the demand condition, indicating that their SIB was maintained primarily by escape from instructions. These data replicate the findings of previous research (e.g., Iwata et al., 1990; Steege et al., 1989) indicating that contingent task removal in the form of brief time-out can serve as negative reinforcement for SIB.

Figure 2 shows the results obtained during the treatment comparison. Karen's data show a high rate of SIB during baseline. When extinction was introduced, her SIB increased above its baseline rate (i.e., there was an extinction burst). Although her rate of SIB subsequently decreased during extinction, it remained somewhat variable, and a close examination of her data revealed that a significant proportion of her remaining SIB occurred immediately following the completion of a trial. As a result, an additional contingency was added to the extinction condition after Session 91. If Karen exhibited SIB between trials, she was presented with a new trial. This contingency was associated with a further decrease in SIB, and she met her termination criterion in this condition in 50 treatment sessions (after Session 109). During the initial sessions of the extinction-plus-fading condition, no extinction burst was evident; her rate of SIB decreased immediately, and the frequency of instructions was faded quickly. However, when the rate of instructions reached approximately 0.6 per minute (nine trials per session), Karen's SIB became more variable and the number of sessions at each instructional rate increased. For example, 27 sessions were conducted at the rate of 1.33 trials per minute (20 trials per session) before she met criterion to fade to the next instructional rate. Although Karen eventually met the criterion to increase the rate of instructions two more times, it

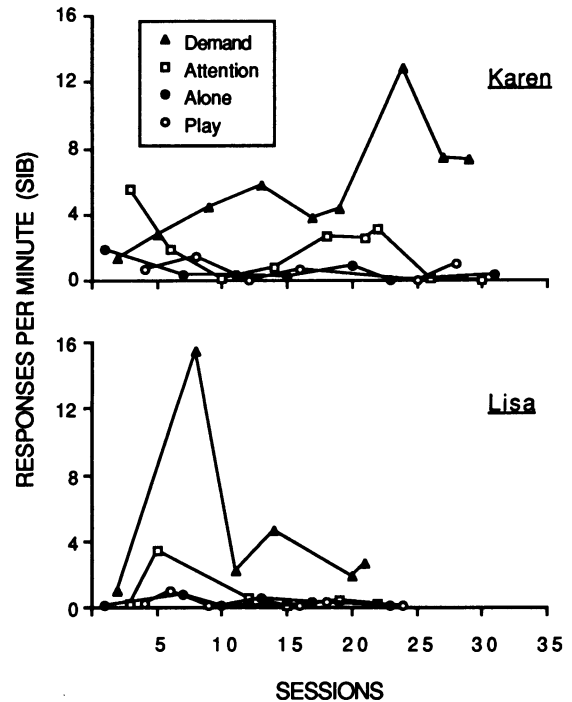


Figure 1. Responses per minute of SIB across assessment conditions.

appeared that the fading procedure did not have the expected effect in reducing her SIB. Thus, the extinction-plus-fading condition was discontinued after 133 sessions.

Although Diane's rate of SIB during baseline was very high during two initial sessions, the other 12 sessions of baseline stabilized at approximately three responses per minute. Following baseline, her rate of SIB rapidly decreased during the initial sessions of the extinction condition, and she subsequently met criterion for treatment completion after only nine extinction sessions. In the extinction-plus-fading condition, Diane's rate of SIB decreased to zero during the first treatment session and remained low throughout the condition as the frequency of instructions was increased rapidly to two per minute. She completed treatment in this condition after 34 sessions. Thus, both treatments were effective in reducing Diane's SIB, and no burst was observed during the extinction condition.

Lisa's rate of SIB also was somewhat variable

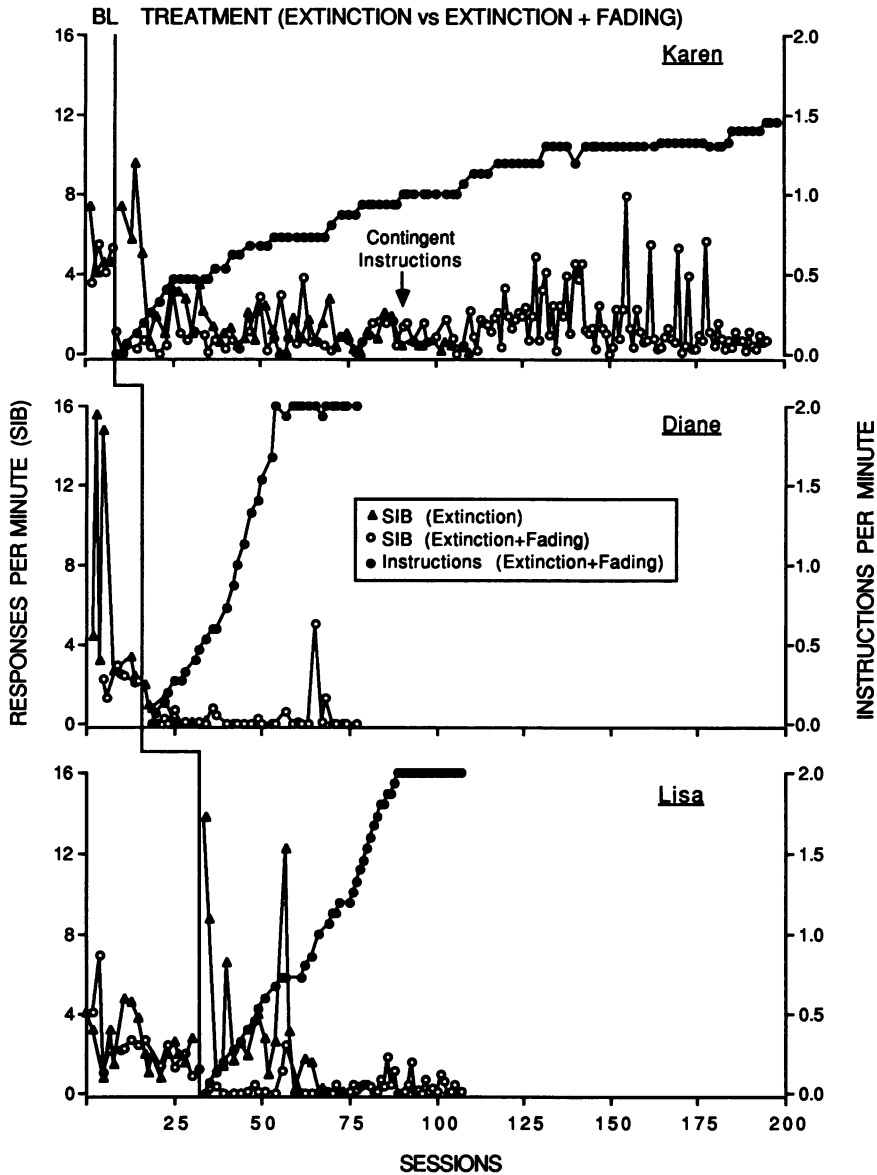


Figure 2. Responses per minute of SIB (left axis) and instructional trials per minute during the extinction-plus-fading condition (right axis) during baseline and treatment. The arrow on Karen's graph indicates when contingent instructions were added in the extinction condition.

during initial baseline sessions, but it stabilized during the 15 sessions at approximately two responses per minute. When extinction was introduced, there was a dramatic increase in SIB during the first two treatment sessions. Her rate of SIB eventually decreased in this condition, and treatment was completed when criterion was reached after a total of 22 sessions. During extinction plus

fading, Lisa's rate of SIB was immediately reduced at the outset of treatment. As the rate of instructions increased, Lisa's rate of SIB continued to remain low, and treatment was completed after 54 sessions.

Following the completion of treatment, staff members at each subject's residence were trained to use escape extinction for SIB when conducting instructional programs. For Karen's and Lisa's staff

members, training (which included modeling, prompting, and feedback) continued until they could perform the procedures consistently. Staff members at Diane's residence were trained more informally. For all subjects, ongoing instructional programs were modified to include an escape extinction contingency for SIB. Follow-up observations conducted over a 6-month period revealed that subjects' SIB remained low (i.e., at or below end-of-treatment levels).

### DISCUSSION

Results of this study extend the findings of Pace et al. (1993) by providing a component analysis of the effects of escape extinction and instructional fading on the self-injurious behavior of 3 subjects. By examining extinction with and without fading in a multielement format, the relative contribution of fading was directly assessed. Results indicated that extinction alone was an effective treatment for SIB but that it was associated with an initial burst of responding for 2 of the 3 subjects (Karen and Lisa). No burst of SIB was observed, however, when instructional fading was used in conjunction with extinction; SIB decreased rapidly at the outset of treatment for all 3 subjects.

Although there was a higher initial rate of SIB in the extinction condition for Karen and Lisa, Karen's only successful treatment was extinction; she never completed the extinction-plus-fading condition. For Diane and Lisa, treatment during extinction plus fading required over twice as many sessions as the extinction-alone condition, even when Diane's fading procedure was accelerated by increasing instructions by two per minute. It is possible that fading could have occurred even more rapidly for Diane and Lisa, resulting in fewer treatment sessions in the extinction-plus-fading condition. Karen's data, however, suggest that an accelerated fading procedure would have been ineffective for her, given that the instructional rate never increased beyond 1.5 per minute. Thus, the rapidity with which fading can occur, as well as the final rate of instructions that can be achieved, may differ across individuals.

For the 2 subjects who successfully completed

both treatment conditions (Diane and Lisa), the number of sessions to the completion of treatment may not be the best index by which the two treatments can be compared. For both individuals, the total (cumulative) number of responses emitted was higher in the extinction condition than in the extinction-plus-fading condition. For example, Lisa's data show that she met criterion in the extinction condition after only 22 treatment sessions, but during that time 995 responses occurred. During extinction plus fading, only 268 responses occurred over 54 treatment sessions. Results were less pronounced for Diane. She exhibited 176 responses over 28 treatment sessions during extinction, compared to 146 responses over 34 treatment sessions during extinction plus fading. The higher total number of responses during extinction is directly related to the burst of SIB at the outset of that treatment condition.

The effects of extinction on Karen's SIB were somewhat confounded. The introduction of contingent instructions after 41 sessions in the extinction condition made it impossible to determine whether the punishment contingency or the additional extinction trials finally reduced her SIB. It was not possible to add this contingency to the extinction-plus-fading condition in an attempt to equate the procedures because the fading aspect would have been eliminated. Thus, when extinction plus fading was not successful after over 130 treatment sessions, treatment was terminated. Nevertheless, the two procedures had very different effects on SIB at the outset of treatment, making Karen's data valid for the purposes of determining whether fading could eliminate an extinction burst.

The results of this study indicate that there are potential advantages and disadvantages to both treatment procedures. Although SIB may be eliminated more quickly when extinction alone is used, the rate of SIB may increase beyond acceptable limits before it is reduced. When instructional fading is implemented in conjunction with extinction, there seems to be an immediate reduction in SIB at the outset of treatment. However, the combined treatment procedure was not effective for 1 subject and required many sessions for the other 2. Thus,

potential severity of the behavior and length of time available for treatment are two factors that may determine whether or not fading procedures should be used in conjunction with extinction.

Future research on the treatment of escape-maintained SIB might focus on further development of procedures based on stimulus fading. In the present study, fading occurred along the dimension of frequency (instructions per minute). Other research (e.g., Weeks & Gaylord-Ross, 1981) has shown that task difficulty is another variable that may increase escape behavior. Thus, it should be possible to develop assessment procedures to determine the aversive characteristics of instructional tasks (frequency, difficulty, duration, etc.) for each individual and to use the results as the basis for developing fading procedures along multiple dimensions.

Another interesting extension of the present study would be an evaluation of instructional fading as the sole form of intervention. If the rate of SIB can be reduced to near zero at the outset of treatment merely by altering instructional variables, perhaps fading procedures can be implemented without extinction. This approach to treatment would eliminate any possible negative side effects associated with the use of extinction, although the rate of fading may be exceedingly slow, and any escape behavior that occurred during treatment would necessarily be reinforced. The first limitation may be merely a practical one. However, the second may be critical in light of the results of other recent studies (Wacker et al., 1990; Zarcone, Iwata, Hughes, & Vollmer, 1993) indicating that extinction is an important and perhaps necessary component of treatment procedures based on the reinforcement of alternative behaviors, such as functional communication training (Carr & Durand, 1985) and high-probability request sequences (Mace & Belfiore, 1990). Thus, although the results of a number of studies, including the present one, indicate that extinction alone can reduce the frequency of behavior disorders such as SIB, additional research is needed to identify the critical components of several combined treatment approaches, including those based on instructional manipulations such as fading.

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